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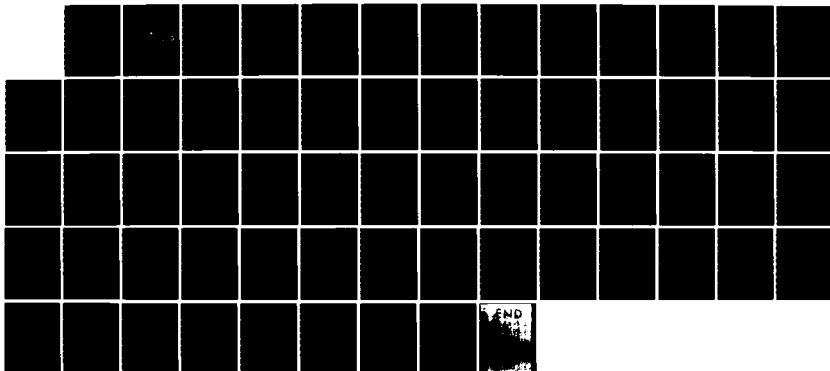
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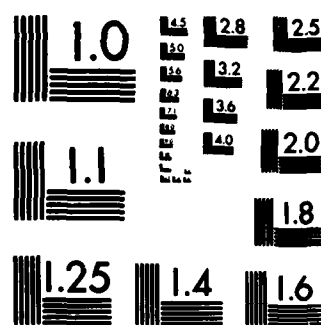
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SYSTEMS ANALYSIS FOR
MICROCOMPUTER ACQUISITIONS

by

H. P. Rhoades

March 1984

Thesis Advisor:

W. J. Haga

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→ a Division Officer, Branch Chief, or small unit Commanding Officer who wants to increase productivity of specific outputs and feels a microcomputer may be the answer. ↗

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Systems Analysis for Microcomputer Acquisitions

by

H. P. Rhoades
Lieutenant, United States Coast Guard
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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

This thesis outlines the procedures for an analysis to be conducted to assist in the acquisition of a microcomputer. It provides a methodology to analyze present system operations, determine technical and economic feasibility of a microcomputer, and select hardware and software to meet organizational requirements. The intent of this thesis is to assist a Division Officer, Branch Chief, or small unit Commanding Officer who wants to increase productivity of specific outputs and feels a microcomputer may be the answer.

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I. INTRODUCTION

A. BACKGROUND

The advancements in computer technology, together with improvements in systems analysis and programming techniques, leading to solidly crafted, flexible software packages are bringing the computer within practical reach of thousands of new end-users in the military. Small branches and departments of large military units unable to fulfill their needs with large organizational computers or small military units unable to access large organizational computers are now able to take advantage of specific computer capabilities more suited to their needs. This trend continues as the cost per unit of computing continues to decline, and administrative costs escalate. The vehicle responsible for this trend is the microcomputer.

The inexperience of buyers and total reliance of buyers on vendors for determining needs have caused microcomputers to be poorly selected, misapplied and misunderstood. They become liabilities instead of assets.

Your best protection is to understand the principles with regard to requirements analysis, how to deal with them realistically, how to make right decisions and drive hard bargains, and to insure that you buy what you need and get what you pay for.

The decrease in cost of microcomputers over the past few years has facilitated the purchase of microcomputers before it is known what functions a microcomputer is to perform. This procedure can lead to high costs in terms of time expended by personnel to make functions fit the computer and also unnecessary or inappropriate equipment/software purchases.

B. THESIS OBJECTIVES

The term "your computer needs" means what you want the computer to do for you.

The purpose of this thesis is to provide a Department Head, Branch Chief or small unit Commanding Officer with a technique by which he can

1. Determine the need for a microcomputer.
2. Acquire the appropriate microcomputer for the organizational requirements.
3. Implement a system that will benefit his decision making.

Buying a microcomputer is not like buying a typewriter. It is more like hiring an assistant. This process will require careful analysis and study before the decision is made and will take a fair amount of work, probably more than the buyer expected.

C. ASSUMPTIONS

The guidelines proposed are to assist in the acquisition of a microcomputer and not minicomputer or mainframe computer. An arbitrary limit of \$10,000 will be used to distinguish

between a microcomputer and minicomputer for the economic analysis of an investment in a microcomputer. The generic guidelines used to determine requirements will be with the assumption of a small military division, branch, or unit in mind for which a minicomputer would be more than is needed. The majority of functions will be internal and not cross organization boundaries.

The intent of purchasing a microcomputer is assumed to be to increase productivity of the division, branch, or unit. It is also assumed that the Division Head, Branch Chief, or Commanding Officer will have little assistance from outside sources while conducting his analysis.

For simplicity sake, Division Head, Branch Chief, and Commanding Officer are referred to as a manager.

II. ORGANIZING

A. PURPOSE

A manager usually does not have the time or opportunity to experiment with computers and slowly gain results. Therefore, careful planning and preparation prior to the acquisition of a computer is essential to providing immediate results.

1. Productivity

The object of introducing a computer into an office is to improve productivity. Productivity can be defined as an efficiency ratio of input resources to output results. Productivity may be improved in any of the following ways:

- Reducing input resources without reducing output results.
- Increasing output results without increasing input resources.
- Increasing output results by proportionately more than an increase in input resources.
- Decreasing output results by proportionately less than a decrease in input resources. [Ref. 1: p. 10]

Some examples of improved productivity are:

- Cost savings through a reduction in labor time or rate in the areas concerned.
- Cost avoidance through an ability to handle an increased workload with less than proportionate labor increases.
- Improved performance of agency mission through improved quality of services.

B. INDICATIONS FOR NEED

Changes in an organization's operations are sometimes gradual and easily overlooked. Below are questions a manager should answer with respect to operations [Ref. 2: p. 71]:

1. Is your workload growing rapidly?
2. Are your responsibilities increasing?
3. Are you falling behind in your paperwork because volume has exceeded your capability to process it?
4. Do you have to add people to your staff to help with the paperwork, even on a temporary basis?
5. Are files beginning to bulge?
6. Are additional space requirements being projected?
7. Do routine tasks dominate your day? Must you constantly pull files to obtain information?
8. Is the work environment becoming chaotic? There is not enough time to analyze problems, only to apply quick fixes.
9. Is vital information lacking when decisions must be made?
10. Are errors and omissions increasing in reports or routine correspondence?
11. Are commitments being missed with respect to deadlines for assignments?

There are changes or circumstances in the workplace that indicate a need for analysis. Affirmative responses to the previously stated questions may justify a need for analysis to determine if more efficient and effective procedures or personnel should be introduced in the present system. Possibly the introduction of a computer is needed.

C. KEY PEOPLE

A manager's initial preparation will be to identify the key people within his area that will be needed to perform an analysis. These people should be familiar with the organizational tasks involved and should be able to contribute experience and time to the analysis. Also, key people should have demonstrated qualities such as good organization abilities, and interpersonal communication abilities. This list will help the manager in recruiting assistance during various stages of the analysis. A sample form that may be used in compiling a key person list is shown as Exhibit 2.1. A manager can prepare this list initially on his own and add or delete entries later on.

D. PRELIMINARY RESEARCH

The next step a manager must take is that of informing personnel of the upcoming project or analysis. At this point, the initial list of key people may be updated or changed based on discussions with his personnel.

The purpose of the analysis should be fully outlined and opinions and recommendations should be solicited to enhance commitment. People become committed to a project when they are asked for an opinion and allowed to assist in planning their future work loads.

The key person list, once established, will be used as a basis for determining the components needed for productivity

NAME	POSITION	SUPERVISORY	EXPERIENCE	COMPUTER EXPERIENCE	EXPERTISE	COMMENTS
John Jones	Finance Mngr.	Yes	4 Years	Spread Sheet	Budget Reports	
Jane Smith	Secretary	No	10 Years	Word Processing	Inter-Office Communication	

Exhibit 2.1 Key People Sheet

measurement. As mentioned earlier, productivity will be the vehicle by which to measure the systems' performance. Productivity includes as its components:

1. Inputs
2. Process or functions
3. Outputs

To come to grips with the concept of productivity, its components must be identified and measured. Using the key persons list, interviews and observation can be undertaken to establish preliminary component identification. It is the purpose of the key person list to gain as much knowledge as possible about personnel, not only to assist in the analysis, but also to ensure that the analysis provides the best system possible using the resources available to a manager.

General information with regards to output preparation, workloads, prior computer experience, etc., can be obtained during interviews and observations which will help establish future criteria for productivity measurement and a workable system. While this gathering of general information is considered preliminary research, it is advisable that an interview guide be prepared to ensure a manager obtains as much relevant information as possible. The type of information that a manager is looking for in his initial interviews may include the following [Ref. 3: p. 15]:

- General information on the output preparation activities, key output contributors, external interfaces to the preparation processes, and annual volume for each output.
- Recommendation for or against computerization of a specific output.
- Judgements as to any specific areas or processes that may be prime candidates for computerization.
- Information regarding prior experience with computers.
- Those productivity factors for each output (i.e., timeliness, responsiveness, convenience, appearance) that appear to be relevant to a manager.
- Information regarding changing workloads and projected organizational changes to be affected in the near future.

The result of this effort should give a manager an idea of major process or function areas of his present system that may lend themselves to further study.

Examples of major function areas are:

1. Accounting
2. Inventory
3. Administrative
4. Personnel.

Accurate identification as to how a function is performed is not necessary, and should only be used as a guideline to categorize outputs into functional areas.

Establishing a key person's list and identifying major process areas should give a good overall picture of the present system. Reviewing this data, a manager must decide as to how extensive the analysis should be. The basis for

this decision will be time, funding, and experience available. Outside assistance may be needed to evaluate the entire system or possibly only a portion of the present needs to be evaluated.

III. ANALYSIS OF NEEDS

A. OVERVIEW

The following five stages for conducting an analysis of an organization are designed to provide a manager with an orderly method for determining specific outputs that would benefit from the use of a microcomputer. It will also provide a manager with a means to measure performance of operations;

Stage 1: Determine Productivity Goals

Stage 2: Analyze Present Operations

Stage 3: Identify Inefficient Output Production

Stage 4: Model Desired System

Stage 5: Final Baseline

It must be emphasized that the amount of detail used within each stage may be dictated by time and funds available to a manager. Greater detail will provide increased accuracy of performance measures and requirements.

B. STAGE 1: DETERMINE PRODUCTIVITY GOALS

Productivity goals must be established to compare the performance of actual production of outputs to the organization's expected performance standards. In a small working environment, the manager may set these goals, based on interviews with key people and his own judgement. While in larger organizations, where outputs are subject to extensive external

review and support, it may be necessary to obtain these performance or production goals from interviews with senior managers or through existing organizational directives. This may also be the case when determining future workloads and volume of output.

C. STAGE 2: ANALYZE PRESENT OPERATIONS

The first step toward any new system is a thorough understanding of the present one. An analysis of a current system will reveal ways to improve it now, without waiting for automation. It may also reveal that automation is unnecessary or impractical, or the improvements that can be effected immediately may render computerization superfluous. A precise picture of current methods, forms, workflows and volumes is the foundation for defining and designing the new system. Understanding the current system implies tying down its costs, which form the basis for justifying proposed changes.

1. Input - Process - Output

Earlier during the preliminary research, major function areas were identified such as administrative, personnel, inventory, and accounting. Key people in each area can be used to identify the outputs, processes, and inputs associated with a specific area. Each output should be listed with the inputs and process necessary to produce it. For example, Exhibit 3.1 [Ref. 4: p. 195] shows an example of a personnel roster output and transfer orders. Inputs required to produce a roster are

FUNCTION AREA: Personnel

KEY PERSON: Sam Smith

WORK PERFORMED BY
(RANK OR GRADE)

No.	OUTPUT	PROCESS		INPUTS
1P	Personnel Roster	Retrieving Records	E-4	Personnel Records
		Verifying Dates & Records	E-5	Transfer Orders
		Type Roster	E-3	Temp. Duty Orders
2P	Transfer Orders	Receive Message	E-5	Personnel Records
		Retrieve Records	E-4	Accounting Data
		Verify Leave & Accounting	E-7	Leave Request
		Personnel Officer Signature	E-7/O-3	Household Goods Data

Exhibit 3.1 Input - Process - Output Sheet

personnel records, transfer orders, and temporary duty orders. The process used includes retrieving records, verifying orders and dates, and typing rosters.

Instead of trying to complete this identification method all at once, it may be simpler to list all outputs and then take one output at a time to associate inputs and processes. Coding of the outputs may be desirable when an area contains a large number of outputs to avoid confusion later.

2. Flow Diagrams

The Input - Process - Output information provides the data to construct flow diagrams. Flow diagrams are helpful in condensing lists of data into a pictorial view of information flow. A flow diagram should be constructed for each output to show the sequence of operations involved in its production. Figure 3.1 depicts a flow diagram for the personnel roster previously mentioned. It is important to ensure that each process, no matter how small, is identified.

When completed, a manager should have a series of flow diagrams identifying information and paper movement activities. He will probably be surprised at the complexity of his operation.

3. Review Flow Diagrams

A review of each flow diagram is appropriate to ensure that all operations have been identified. Walk through each flow diagram step by step and fill in where you find holes.

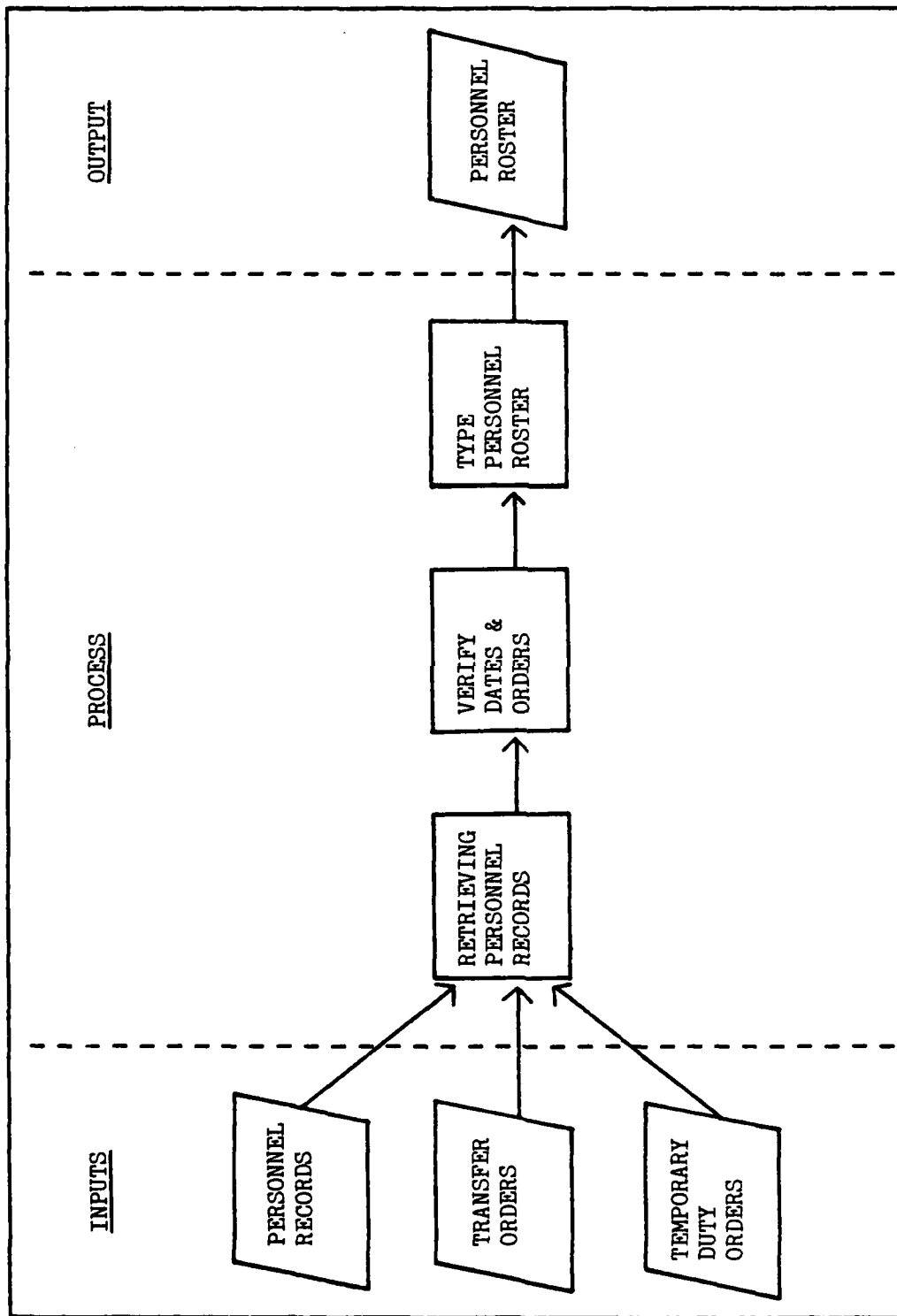


Figure 3.1 Inputs - Process - Output Flowchart

Figure 3.2 shows the personnel roster flow diagram with added activities. Refiling and photocopying have been added, and while they may seem trivial, they are part of the process and should be recorded.

4. Annotating Flow Diagrams

Notes can be added to each operation to reflect such things as number of times performed, time required to perform, or cost of preparation. This is where the amount of detail and accuracy could be severely constrained by the amount of time and money available to a manager. A detailed time analysis could be conducted to provide as much accuracy as possible. It may be more realistic to interview key people or simply observe operations to estimate characteristics associated with operations. Examples of other characteristics to annotate the flow diagrams are peak operations (amounts, time), cyclical operations, periodic operations, and who performs tasks.

Figure 3.2 shows an updated personnel roster flow diagram with notations. Annual figures can be summarized as shown in the bottom left corner. The objective is to produce a flow diagram with enough relevant information to assist a manager in understanding the present system as much as possible.

The cost of operations performed can be computed using the pay rate of the individual performing a specific task. The total cost of producing key outputs is a baseline from which a manager can compare alternatives to the present system.

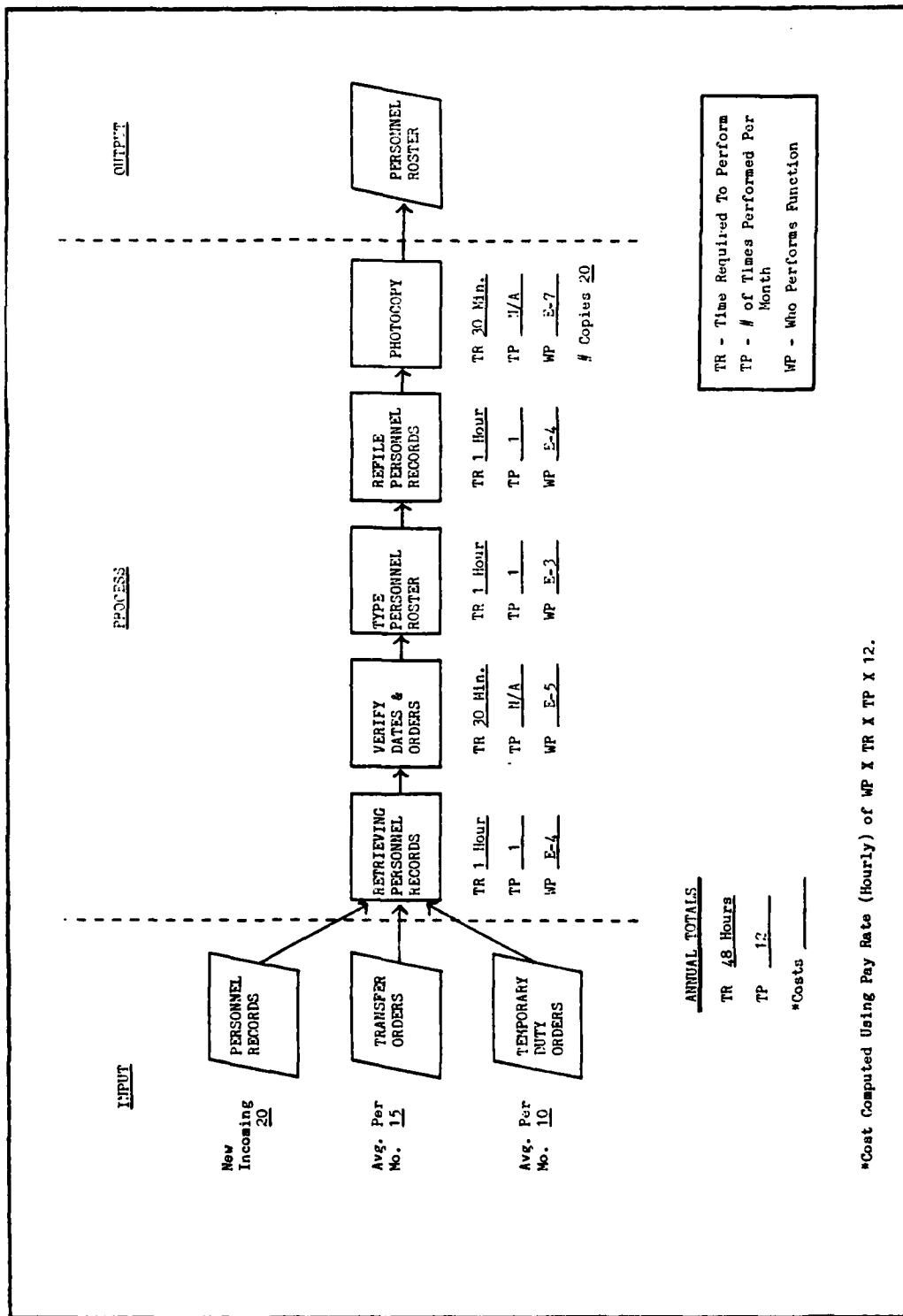


Figure 3.2 Input - Process - Output Flowchart (Expanded)

D. STAGE 3: IDENTIFY INEFFICIENT OUTPUT PRODUCTION

The information gathered and the flow of effort indicated to this point can be evaluated by the manager to identify work blockages, unnecessary delays, redundant outputs, or other factors that may need changing or refining to increase the efficiency of the current system. Obvious problems may be recognized and immediate manual changes may be made. All changes to the system, once accomplished, must be reflected in the accompanying flow diagrams and in the baseline for comparison of alternatives, should the manager still feel it necessary to computerize his work area.

The foregoing analysis should provide first, a complete breakdown with accompanying information of outputs that are presently being produced efficiently and within the guidelines of established productivity objectives. Secondly, a breakdown with accompanying information of outputs that are not being produced efficiently or are being produced below productivity levels previously established.

The prime concern for a manager is with those outputs identified as being produced below established productivity levels. These must be reviewed carefully to determine that changes can be made to increase the level of productivity. Before jumping into changes, it is advisable for the manager to ensure that the performance goals or productivity levels established for these outputs are realistic and attainable. Information provided from initial interviews with key people

and upper management may have already indicated a need for revision of goals or that the goals are reasonable. Assuming the latter to be the case, or that revised goals have been established, a manager should examine each output separately to determine changes necessary to meet these goals.

There are three types of changes to be considered when examining outputs [Ref. 5: p. 35]:

1. Organizational changes, which would relocate a process to different area for production.
2. Procedural changes, which encompasses reassigning personnel to the appropriate process to be performed.
3. Technological changes which require the use of technological advancements to improve productivity.

These changes or improvements must be considered together when reviewing an output. It may be determined that an output is being produced slowly because there are too many reviews by upper management associated with it. This would require a procedural change to reduce the amount of personnel involved reviewing an output. It may also require an organizational change to remove a process or function from an external department. Both of these may require approval from upper management and also entail compromise to satisfy personality conflicts which may arise. The technological change can also be examined to determine if, for example, a new distribution system or word processor will enhance production.

E. STAGE 4: MODEL DESIRED SYSTEM

Should the production of an output be determined as inefficient or in need of change to achieve its productivity goal, requirements to increase productivity have to be established. This in effect is modeling a new system to accommodate the production of an output to meet its productivity. This type of analysis closely parallels the work done by Tom DeMarco with respect to Structured Analysis. In his book, he describes the seven steps [Ref. 6: p. 27] of Structured Analysis, three of which are:

1. Study of the current physical environment, resulting in its documentation by a Current Physical Data Flow Diagram.
2. Derivation of the logical equivalent of the current environment, resulting in a Current Logical Data Flow Diagram.
3. Derivation of the new logical environment, as portrayed by the New Logical Data Flow Diagram plus supporting documentation.

While his emphasis is on designing a computer system to meet the needs of the user and he accomplished this by analyzing functions or processes rather than outputs first, it is similar to what is being recommended in this thesis, in that you must break down your tasks and analyze them to first understand what is being done before you can change it.

The approach being taken here is an information-oriented analysis to identify and define the information required to make a decision, or the form or report that is required and then secondarily, define the input data and processing

required to produce the desired information. In the context of "input - process - output", the primary focus is on the output [Ref. 7: p. 34].

It should be stated as a reminder that the purpose of this analysis is for the determination of the need for a microcomputer, not a minicomputer or a mainframe. If a manager at this stage of analysis finds that the majority of outputs are being produced inefficiently, this may indicate the need for a larger computer than that of a microcomputer and possibly a new system for the entire organization rather than just his work area. This would involve a much more detailed analysis and require the assistance of top level management and personnel throughout the organization. The designing of a model system would be required and the reader should consult DeMarco's structured analysis approach.

The premise being used in this thesis is that the manager finds that the majority of his outputs are being produced efficiently and that the use of a microcomputer may enhance the production of those few outputs that have been identified as needing assistance. Normally, this would entail a stand alone microcomputer or possibly two connected microcomputers.

Each inefficiently produced output must be examined to determine the changes needed to provide the optimal process. When the optimal process is decided, a new flow diagram is prepared to reflect the changes, and the increase in productivity expected should be recorded. Remember that changes to

one output may effect the production of another. Therefore, after the individual analysis for outputs is conducted, an overall view should be conducted to update the effects that these changes will have on the organization and the efficiently produced outputs. In addition, all outputs should be reviewed with respects to expected volume increases and future contingencies which may effect productivity. Changes or improvements considered previously should take these contingencies into account. The new flow diagrams constructed for outputs will be used to establish the requirements necessary.

A requirements list can be prepared for each reconstructed output flow diagram. Examples of requirements needed to enhance productivity and possibly reduce costs are reduction of filing time, photocopying, and typing revisions; increase accuracy and timeliness of production; allowance for additional information to be recorded. These requirements can be divided into mandatory and desired categories. Mandatory requirements refer to characteristics of an output that are needed to bring it up to productivity goals. Desired requirements include characteristics needed to meet estimated future workloads or increase productivity levels beyond present goals.

F. STAGE 5: FINAL BASELINE

A manager now has first, a complete picture of the present performance of the system and its productivity; secondly, a modelled design for a system that is desired to meet

performance or productivity goals; and thirdly, a listing of requirements needed to produce each output, both mandatory and desired. It should also be known at this time what processes and outputs would benefit from the use of a micro-computer and the anticipated productivity increases associated with this use. In terms of productivity, the manager should have the knowledge to determine if a large organizational computer or minicomputer for his work area would be appropriate. It may also be determined that the present system, with organizational and procedural changes, is appropriate without the use of a computer.

The final baseline will be used for determining the performance of a system that has been implemented.

IV. TECHNICAL AND ECONOMIC FEASIBILITY

A. TECHNICAL FEASIBILITY

1. Software

Software presently on the market will determine if an output can be produced on a microcomputer. Therefore, a manager must survey vendors to find software capable of producing the outputs identified during the analysis stage.

A manager must be flexible during this survey, realizing that off-the-shelf software may not suit his needs exactly. It must first be determined if there is software to produce an output and secondly, how much modification will the software need to conform to the requirements. If modification is necessary, a manager must evaluate the complexity. For example, extensive programming changes may be needed which makes the software impractical to purchase based on the experience level of a manager's personnel. On the other hand, a software package may only need data entered in a certain format, which can be a simple task to accomplish.

Software survey sheet (Exhibit 4.1) can be used to record information during the review of software with vendors. A sheet is prepared for each output being considered, and the requirements necessary for the production of a specific output will be used as the basis for the survey. Hands-on manipulation by the user prior to purchase of a software package will assist in obtaining information pertaining to

Output _____

Software Package Name _____

Vendor Name _____

Operating System Required _____

Memory Required _____

Data Entry Ease _____

Ease of Use _____

Error Message Quality _____

Vendor Updates _____

Documentation Included _____

Expansion Capability _____

Minimum Requirements Met Yes _____ No _____

Modifications Necessary _____

Other Features (ie., Training, Maintenance) _____

Cost _____

the software performance. Information such as data entry ease and error message quality are subjective features and can best be evaluated by direct use. Cryptic error messages which do not explain to the user what mistake was made and how to recover are usually considered unsatisfactory.

Most software packages are designed to run on a specific operating system. Specifying the operating system will be useful in hardware selection.

2. Memory

It is advantageous for a manager to have a rough idea of what memory size will be needed. Now that a manager has isolated the outputs that can be produced by a microcomputer, the amount of memory for data can be determined. Each output flow diagram should have an example of inputs required for the production. Count all the characters contained in an input. Each character (letter, number, punctuation symbol, etc.) is coded as a byte of eight bits in a computer memory. Therefore, the total characters contained in a specific input can be multiplied by the volume of inputs used to obtain the amount of computer memory required. Using our personnel roster example, assume each personnel record contains 500 characters and there are 100 records. To store these records would require 50,000 bytes of memory.

The memory required for a specific software package will be obtained from the vendor. A summary sheet such as

Exhibit 4.2 is used to combine the information about software for easier review and also to help in selecting hardware.

B. ECONOMIC FEASIBILITY

1. Hardware

Once usable software packages have been isolated, the hardware required to support them can be defined.

Agency regulations will dictate the monetary thresholds [Ref. 8: p. 33] for which specific acquisition policies apply. If a Request for Proposal is required, specifications can be documented using information derived from the requirements analysis and software survey. The monetary threshold may be such that three price quotations are necessary to accomplish an acquisition. A survey of vendors to obtain price quotations will have to be done.

The hardware cost summary sheet (Exhibit 4.3) [Ref. 9: pp. 90-91] gives a form on which to cost items offered by vendors. The memory requirements recorded on the software summary sheet will help to determine the size of microcomputer needed.

Each type of microcomputer that will satisfy the software requirements will be priced. When completed, an average of the vendor's total costs can be used for the Hardware Total of Total Cost Summary.

The Total Cost Summary (Exhibit 4.4) will give the total cost to initially purchase a microcomputer and also the monthly costs (recurring) to operate.

Vendor Name	_____
Software Packages Available	_____ _____ _____
Operating System Required	_____
Total Program Memory Size	_____
Data Memory Size Required	_____
Error Message Quality	_____
Data Entry Ease	_____
Ease of Use	_____
Adequate Documentation	_____
Expansion Capability	_____
Total Software Cost	_____

Exhibit 4.2 Software Summary Sheet

Model Features	_____	

		Cost _____
External Memory		
Floppy Disk Drives	_____	
No. Desired	_____	
Size	_____	
Features	_____	
		Cost _____
CRT Terminal Features	_____	

		Cost _____
Printer Speed	_____	
Features	_____	
		Cost _____
Added Items		
Cable	_____	
Paper	_____	
Other	_____	
		Cost _____
Total Cost		_____

Exhibit 4.3 Hardware Cost Summary Sheet

I. Hardware Total _____

II. Software Packages

A. Output 1 _____

B. Output 2 _____

C. Output 3 _____

Total _____

III. Maintenance

A. Software (contract) _____/month

B. Hardware (contract) _____/month

Total _____

IV. Installation _____

V. Training _____

VI. Operating Cost

A. Power

B. Supplies

1. Paper _____/month

2. Floppy Disks _____/month

3. Printer Ribbon _____/month

Total _____

Total Cash Outlay _____

Recurring Costs _____/month

Exhibit 4.4 Total Cost Summary

2. Other Costs

Maintenance costs will usually be the amount of the contract from the vendor supplying maintenance. Vendor support may be critical and should be incorporated into the evaluation. Factors such as turnaround time for repairs, replacement machines during period of repairs, and reliability of equipment should be considered when evaluating hardware.

Training costs are a little more difficult to estimate. The vendor may supply initial training but an estimation of time for personnel to learn must be made. This can be converted to costs, using pay rates. A factor to look at that may reduce training time is understandable documentation. Tutorials and other documentation supplied by the vendor should be written so the user can easily understand. Avoid documentation apparently written for programmers.

C. COST/BENEFIT

The purchase of a microcomputer usually will not require a full cost/benefit analysis. A manager has a total cost to purchase a microcomputer and the software packages necessary to produce those outputs earlier identified as being produced inefficiently.

Using the information acquired during the software review, the flow diagrams can be made to incorporate the microcomputer operations on the selected outputs. Estimations can be made as to the reduction in time and personnel that will be

achieved. The new estimations for the production of an output will be compared to the present costs of producing the specific output. The cost savings can be computed. Time saved by personnel can be used on other outputs not to be computerized, thus producing savings or increasing productivity of an unrelated output.

The primary concern is to increase productivity and reduce costs.

A comparison of the present system's recurring costs and the proposed system's costs (initial investment plus new estimated recurring costs) can be made over the anticipated economic life of the microcomputer. This does not take into consideration present value of money and should be used only as a rough measurement of financial benefits to be derived from the acquisition of a microcomputer.

The economic life is defined as that period of time over which the savings or benefits to be gained from an investment may reasonably be expected to accrue. Economic life is normally determined by estimating that time period when replacement of a microcomputer will be necessary due to physical or technical obsolescence [Ref. 10: p. 7-1].

There are various methods to compute cost/benefit data such as discounted payback, break-even, present value, and savings/investment ration. Again, agency regulations may dictate a specific method to use.

V. IDENTIFYING AND REDUCING RISKS

A. OVERVIEW

The computer introduces new risks to a workplace as well as increasing some of the existing risks. Once the decision has been made to acquire a computer, the risks associated with that acquisition must be identified and a determination made as to the action that must be taken to minimize the effect risks will have on the organization. The person identifying the risk must understand his organization and must also have a general understanding of what can go wrong with computer systems. The bringing together of these two areas will produce an understanding of the most probable computer risks.

The objective of this chapter is to provide an overview of common risks associated with the acquisition of a computer. The risks are divided into the following three categories [Ref. 11: p. 32]:

1. Acquisition Risks: The risks associated with acquiring a computer.
2. Implementation Risks: The risks associated with specifying, designing, and implementing computer applications.
3. Operational Risks: The risks associated with the operation of computerized applications.

B. ACQUISITION

The main risk associated with the acquisition process is to select the wrong software and hardware to accomplish the organizations' objectives.

Chapters III and IV place the responsibility on a manager for doing the majority of analysis and evaluation. In reality, delegation of analysis and evaluation responsibilities may occur. While it is advisable to include potential users of a proposed system to accurately describe needs, it is essential that a manager be involved during the entire process leading up to and after the decision to acquire a microcomputer.

The introduction of a microcomputer may affect the operation of the entire workplace and not just the areas specifically designated to be computerized. Users tend to concentrate only on the areas they are responsible for when evaluating a change in procedures. A manager must be able to evaluate the affects of computerization on the total workplace. Therefore, to minimize the risk of selecting the wrong software and/or hardware, a manager must ensure that a complete study be undertaken, that requirements be documented and agreed to by the users, and that the hardware and software selection process adheres to those requirements [Ref. 12: p. 78].

C. IMPLEMENTATION

The majority of effort during the acquisition process is concerned with obtaining and documenting information to assist

in determining the best system to acquire. The best system will be that which meets performance requirements at the lowest cost. All too often, preparation and planning for the integration of a microcomputer into the organization is either poorly done or non-existent. The risk of non-acceptance of change by personnel and failure of a new system is increased should preparation and planning be ignored.

A smooth transition from the present system to the new system is essential to a system's success.

- Training requirements
- Data conversion
- Schedules
- Physical requirements
- Job classifications
- Implementation control procedures

must be clearly identified and a realistic plan of action should be documented to address these areas.

1. Training

A concise training plan should be prepared prior to the installation of a microcomputer. Specifically, the plan should designate who will receive the training, what type of training will be offered, and when the training will be conducted.

First, identify the primary users of a new system and review their level of computer experience. Referring to the key people list will provide information pertaining to

computer experience. Second, compile a list of training available from the vendor, on-the-job, and other sources. Third, determine milestones or review points necessary to evaluate training progress. An implementation schedule and goals to be accomplished should be defined and agreed to by users. Dates can be set for demonstrations of pre-defined functions and features of the new system such as the preparation of a report in a specific amount of time. Fourth, establish realistic time requirements necessary to complete the training. Fifth, coordinate the above information into a realistic and detailed training plan [Ref. 13: p. 202].

When designing a training plan a manager should encourage the cooperation and interjection of input by users to ensure that the plan is realistic and will meet user's needs.

2. Physical Requirements

Don't wait until there is a box in the middle of the workplace to decide where a microcomputer is going to be placed. Determine the physical requirements of a microcomputer and prepare the area well in advance of its arrival. Consideration should be given to the following requirements:

- Power sources - enough power outlets must be available to accommodate the computer and the peripherals that accompany it. Ideally, outlets should be dedicated for the computer's use.
- Cleanliness - dust, dirt, and smoke is very detrimental to a computer's operation. An area that can be maintained to reduce such hazards should be chosen.

A no-smoking area and an area not traveled frequently by personnel are examples. Controls restricting eating and drinking in the computer area will also help to maintain a clean environment.

- Security - most microcomputers and peripherals are of a size that allow the possibility of theft. Security measures should be established for hardware and software protection.
- Storage - adequate space for a computer's documentation, disks, printer paper, and other supporting equipment is necessary.
- Furniture - incorrect chair height, video display screen position, workspace height can cause users to experience back or neck ailments. Size of workspace for documents when entering data, printer location with respect to the data entry area, and space for collating printed material are factors to consider when selecting furniture to support a microcomputer. Most computers will require a floor covering such as a rubber mat to eliminate static.
- Lighting - video display screens should be positioned to reduce glare from sunlight and indirect lighting such as overhead fluorescent lights. The glare from a screen can cause eye strain problems among users.

3. Data Conversion

Data conversion to a microcomputer can be tedious and time consuming. Controls need to be established to ensure data is being transferred to the microcomputer accurately. Controls such as daily audits or reviews may be necessary. A schedule for data conversion can be prepared, thus reducing the perception of the need for immediate data transfer by users. Schedules will also indicate the phased in use of a microcomputer. For example, it may be necessary for personnel to operate the present system and the new system in parallel for a period of time. This requires that a manager establish control mechanisms to define how operations are to be run.

4. Job Assignments

The introduction of a computer into the workplace may require job classifications to be redefined and job assignments shifted.

A manager should review the organization structure and position descriptions of personnel to determine what revisions will have to be made. It may not be appropriate to formally revise the structure or position descriptions before installation of a microcomputer, but a review will help the manager in determining the affects changes will have on personnel.

5. Resistance

Installing a computer system will disrupt established office routines and change the way people do their jobs. Unless it is properly introduced, the computer may cause resentment. People may feel that it threatens their jobs.

Make certain that everyone understands why the computer system is being purchased and how personnel will benefit. The computer will be doing tedious, repetitive tasks to free personnel to do more creative work. Working with a computer will also give them new and valuable skills.

Carefully consider which employees will be receptive to change and which ones will resist. How you introduce a computer can have a lasting effect on personnel and the efficiency of the system [Ref. 14: p. 1/5].

6. The Plan

An implementation plan should be designed to inform personnel of their responsibilities and to describe how the implementation of a microcomputer will take place and it should be as specific as possible. Without accurate information, users and management will become confused and subsequently resist the proposed changes.

Management and user involvement in the preparation of an implementation plan is recommended as much as practical, first to promote cooperation and secondly, to ensure requirements and needs are being met.

D. OPERATIONS

The risks associated with operations are often attributed to inadequate planning. It is essential that these risks be addressed and requirements established to reduce risks before the acquisition takes place.

Careful review of maintenance contracts and vendor reliability is necessary to ensure that hardware and software problems will be fixed in a timely manner. Inadequate maintenance can cause costly delays and force total shutdown of a system. Backup data and systems need to be determined in the event a microcomputer is inoperative. This may require a parallel manual system, duplicate files or replacement systems.

Security precautions must be established with regards to access to data theft, intentional and unintentional damage. Passwords, secure areas, custody controls, and operating regulations should be formalized as appropriate.

Audit controls to ensure data integrity (accuracy) need to be established. Software packages can be obtained to produce audit functions or a manual system can be devised.

User requirements not being satisfied and poor performance by a microcomputer during operations are most attributable to inadequate planning. Chapter III stresses the importance of documenting accurate user needs and determining performance specifications.

VI. CONCLUSION

The acquisition of a microcomputer for an organization is a major decision. Although costs of a microcomputer, due to technological advancements, have decreased over the years, the effects of computerization will be experienced by all or most operations within the organization.

It should also be recognized that the purchase price of a microcomputer can be minimal compared to the costs of determining the best computer to meet the requirements and needs of an organization. The methodology presented in this thesis is designed to help a manager efficiently and effectively use his decision-making time. It accomplishes this by:

First, showing a manager how to analyze the present system's needs.

Secondly, it helps a manager determine which outputs are suitable for computerization.

Third, it helps a manager select the best system from vendors, that will meet the organization's needs.

The extent to which the analysis and preparation is taken, depends on the complexity of an organization. It may also depend on requirements imposed by local and agency regulations. Reviewing regulations and initially assessing the complexity, may require modification of the methodology and worksheets presented.

The technical aspects of microcomputers have been omitted because it is not felt that technical knowledge will greatly

assist a manager in the decision making process. How a micro-computer accomplishes a task is not as important as ensuring that user requirements are being fulfilled.

The importance of system analysis cannot be overemphasized. It requires hard work and time to accomplish, but will produce lasting and beneficial decisions for an organization.

APPENDIX A

GLOSSARY OF BASIC TERMS THAT DESCRIBE SMALL COMPUTER SYSTEMS

Application Program

A program you use directly to do something with the computer such as work processing, accounting, spreadsheet calculations, data filing, time scheduling or to play games.

Communications

Computer communication is essentially the sending of signals by telephone to another computer. The advantage of phone links is that they make all computers just about equal. The smallest portable personal computer can talk to the biggest mainframe if they do it by phone.

Computer

The piece of hardware that contains a set of printed circuit boards that hold the CPU along with the on-board memory and other devices that manage the disk drives and handle connections to printers and terminals. Also loosely called the CPU.

The dimensions of a computer are those of its CPU as well as the size of its on-board memory (also called the RAM or random access memory) measured in thousands (called K's) of characters (bytes) it can store. The usual range is 64K, 128K, and 256K.

CP/M

A brand name acronym for a popular microcomputer DOS. It stands for Control Program / Microcomputer. CP/M is the creation of Digital Research, Inc. of Pacific Grove.

CPU

An acronym for Central Processing Unit, the microscopic circuitry where the computing is actually done. CPU is often used as a synonym for computer. Another in exact term for the CPU is "the chip." Common brand names for CPU chips are Z80, 6502, 8086, 8088, and 68000.

A CPU has two dimensions: size of its "word" and its calculation speed. Word sizes are measured in number of bits. The usual range is 8 bit, 16 bit, and 32 bit. Calculation speed is also called clock speed. It is measured in millions of operations per second (megahertz or Mhz). The usual range is 2Mhz, 4Mhz, 6Mhz, and up multiples of two.

Crash

Crash is a colloquial term that describes a computer program that inadvertently stops running. Usually the cursor disappears from the screen and the system no longer responds to attempts to enter data. Other terms are lock-up and freeze.

Data Base

A data base is an electronic filing cabinet. Some data file managers are just that. But true data bases are much

better. A data entry is done only once for the whole system of uses. For example, a change to an account name is made only once. Automatically, all files, lists programs, or reports using that name have its new, corrected version.

Data File

Just like a drawer of 3X5 cards, a data file consists of a collection of individual records. Records on individual employees would comprise a personnel file.

Data Record

Akin to a 3X5 card, a data record contains information on a single person, piece of equipment, account or inventory item. Name, address, city, state, ZIP code, Social Security number, telephone number, and date of birth could be the information fields that, together, comprise a "record" on John Doe.

DOS

An acronym for Disk Operating System. Another way of saying operating system. Each manufacturer of computer hardware usually creates its own unique operating system to run it. In the microcomputer world, there are some DOS's that can run on the equipment of several manufacturers. The brand names of these DOS's are CP/M, MS-DOS, and UNIX. UNIX also runs on minicomputers and was created originally to run large mainframe systems.

Floppy Disk

A circle of thin plastic coated with a film of metallic oxide (the same as is used on cassette tapes) which is packaged inside a stiff cardboard jacket. The oxide layer holds electronic pulses in magnetic patterns. It is floppy only by comparison to the other form of permanent magnetic memory, the hard disk. A floppy disk can be used by placing it in a disk drive. When not being actively used, a floppy disk is filed in a disk container.

Floppy disk systems are measured in three dimensions: diameter, density, and sides. Floppies come in three diameters: 8", 5¼", and 3". Some floppy disk drives cram twice as much data on a disk (double density drives) than other (single density drives). Moreover, some drives use only one side of a floppy disk while others use both sides.

All floppy disks have a particular format for storing electronic pulses depending on the brand of computer. Consequently, most floppy disks cannot be used in a computer system of a different make. Sometimes they are incompatible even within one manufacturer's line of equipment.

Hard Disk

A rigid, circular disk of light metal (probably magnesium) coated with a film of metallic oxide (as is used on cassette tapes). A recording and playback head files above the spinning disk. The disk can hold electronic pulses in magnetic patterns in the metallic oxide layer.

Small hard disks are called Winchester (a nickname picked up from earlier IBM code for them, 3030, which is the gauge of the Winchester rifle). Winchester hard disks are sealed into their drives and cannot be removed. Some hard disks systems have two drives: one sealed and the other removable (called a disk cartridge).

The chief dimension of hard disks is their memory capacity. This is measured in millions of characters (known as bytes) that they can store. A million character unit of measurement is a megabyte or "Mb." The usual range is 5Mb, 10Mb, 20Mb, and 40Mb.

On-Board Memory

This is the memory inside the computer that you use when the computer is working. It is temporary. When the computer's power goes off, the on-board memory is erased. This memory is also called random-access memory (RAM), buffer, core, and scratchpad.

Operating System

This is the program of programs, the master program that is the traffic cop that directs the running of the other programs that you use directly such as word processing or accounting. In a good system you will never notice the operating system. Its work will be "transparent" to you the user.

Peripheral

A piece of equipment that is not part of the central computer itself is called a peripheral. This usually means disk drives, printers, communication modems, and terminals.

Software

Software consists of computer programs. A computer program is a set of electronic pulses that direct the hardware in a computer system to do something useful for you. Software has two broad categories: the stuff you use directly and the stuff you don't. What you use directly are called "application" programs, e.g., word processors, accounting programs, spreadsheets, time managers, or data file managers. What you don't use directly (unless you are a programmer) are operating systems, programming languages, and other things called utilities.

Terminal

The terminal consists of a video display and a keyboard. You communicate with the computer through the keyboard. It talks back through the video display (it can also talk to you through a printer but that's cumbersome). In small home systems, the video, keyboard, and computer get packaged into one unit. Heavy duty business systems usually have several terminals working off of a single computer.

The dimensions of a terminal are screen size and color, number of keys, special purpose keys, detachable keyboard,

and physical flexibility of the video display mounting (does it tilt, swivel, raise up and down?).

Word Processing

The term is used to contrast what it does with what is done by data processing. In data processing, only numbers are manipulated. In word processing, words are manipulated: stored, displayed, edited, formatted, and sent to a printer. Even the most primitive word processors render great leaps in office productivity compared to using a typewriter.

The above terms were paraphrased from the Running Press Glossary of Computer Terms [Ref. 15] and Microcomputer Dictionary [Ref. 16].

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